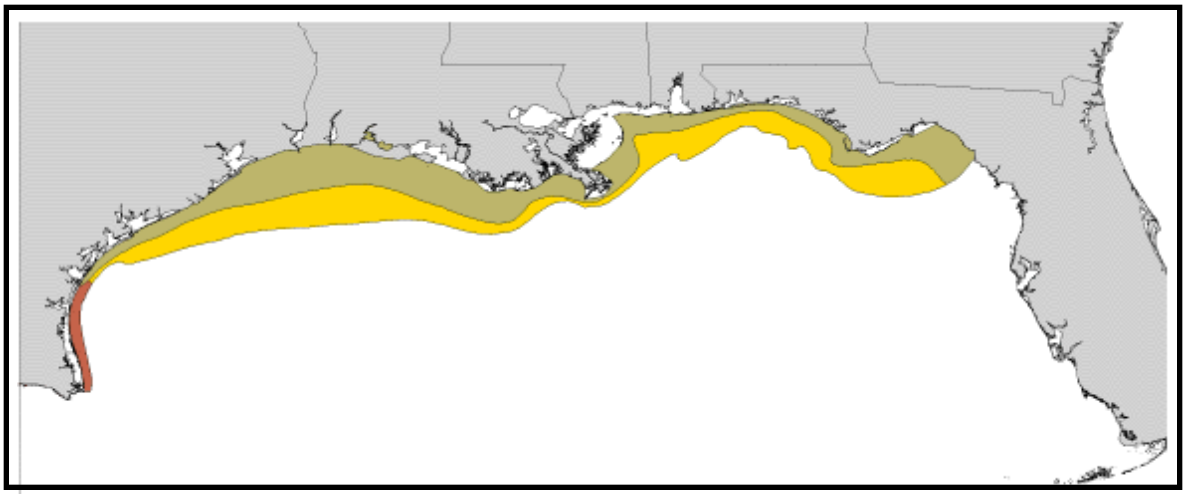
PRODUCT OVERVIEW

Products and Services for the Identification of Essential Fish Habitat in the Gulf of Mexico



Strategic Environmental Assessments Division
National Ocean Service

In Cooperation With

Southeast Fisheries Science Center
National Marine Fisheries Service

and

Gulf of Mexico Fisheries Management Council

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Ths document briefly describes the products developed cooperatively by the National Oceanic and Atmospheric Administration's (NOAA's) National Ocean Service (NOS) and National Marine Fisheries Service (NMFS), and the Gulf of Mexico Fishery Management Council (Council) to identify Essential Fish Habitat (EFH) in the Gulf of Mexico. These and other products will be used by the Council to amend their fishery management plans in accordance with the EFH requirements of the re-authorized Magnuson-Stevens Fishery Management and Conservation Act (NMFS 1998). The Minerals Management Service's (MMS's) Gulf-wide Information System (G-WIS) project provided key support and guidance in the development of the estuarine and marine species maps (Strategic Environmental Assessments Division 1997). Generating the map products would have not been possible without the outstanding cooperation of the state environmental agencies, federal agencies, and academic institutions in the Gulf of Mexico region, which provided the bulk of the estuarine fishery-independent monitoring data and peer review of map products developed from those data (see Acknowledgments).

Digital, hardcopy, and internet maps and information products have been developed. For a more complete description of the joint NOAA and Council efforts, please refer to the *Work Plan: Products and Services for the identification of EFH in the Gulf of Mexico*, available from NOS's Biogeographic Characterization Branch (BCB) (NOS/BCB and NMFS/Galveston 1997).

To view the products delivered to the Council, please visit the BCB's Gulf of Mexico EFH website:

http://christensenmac.nos.noaa.gov/gom-efh/

This **DRAFT** site was developed to exchange information between NOAA and the Council for review purposes. The site will continue to evolve as information on species distributions, relative abundances, and life histories is updated. In the future, additional species and habitat databases, and associated maps, will be incorporated from NOAA, MMS, and State studies.

NOS'S ESSENTIAL FISH HABITAT PRODUCTS

Nationwide, NOS's BCB is conducting the following four tasks to support EFH requirements.

Task 1. Conduct EFH needs assessment.
Task 2. Provide Digital Spatial Framework for EFH mapping.
Task 3. Provide existing biological and habitat databases.
Task 4. Accelerate development of ArcView species mapping tool.

BCB has developed the EFH products listed below to support NMFS and the Council in their program to meet EFH requirements for the Gulf of Mexico. Similar product suites have been, or are being, developed for the South Atlantic, Mid-Atlantic, North Atlantic, and West Coast regions.

Item 1. Needs assessment.
Item 2. Work plan.
Item 3. Digital Spatial Framework.
Item 4. Additional Data compilation.
Item 5. ELMR species/estuary tables.
Item 6. Non-ELMR species/estuary presence/absence tables.
Item 7. Selected estuarine species maps.
Item 8. Digitized atlas maps for offshore species.
Item 9. Non-atlas offshore species presence/absence maps.
Item 10. Estuary/embayment habitat maps.
Item 11. Offshore habitat maps.
Item 12. Regional salinity and relative abundance maps.
Item 13. Life history tables and text.

NOS's BCB has built upon three of their major strategic assessment programs in conducting the Gulf of Mexico EFH work. The Estuarine Living Marine Resources (ELMR) program has developed relative abundance estimates for 44 species in 31 Gulf of Mexico estuaries (Nelson *et al.* 1992), and has also developed detailed life history summaries for these species (Pattillo *et al.* 1997). *The Gulf of Mexico Data Atlas* (Strategic Assessment Branch 1985) contains maps and life history information on 62 fishes and invertebrates, with greatest detail for offshore regions. The Coastal Assessment Framework (SEA Division 1993) contains geographic information system (GIS) files for coastlines and watersheds for the contiguous states.

Areas Covered. Information and maps were developed for the region for which the Council has jurisdiction. This region includes 32 estuaries (Table 1), extending from Florida Bay, Florida, to Laguna Madre, Texas. The offshore maps cover state and Federal waters to the U.S. Exclusive Economic Zone between Key West, Florida and the U.S.-Mexican border.

Species Covered. Managed species in the Gulf of Mexico are listed in Table 2. Because of the time constraints imposed by the Magnuson-Stevens Act, 26 representative species were chosen by NOS, NMFS, and the Council. At least one representative species was chosen for each fisheries management plan. Table 3 lists the estuarine and offshore occurrences for the representative species; estuarine and offshore products were developed for each species in accordance with Table 3 for this

initial EFH effort. In the future, joint NOS and NMFS efforts may address additional species, life stages, habitats, as well as threats to EFH.

Table 1. Gulf of Mexico estuaries for EFH mapping of species and habitat.

Florida Bay	Breton/Chandeleur Sound
South Ten Thousand Islands	Mississippi River
North Ten Thousand Islands	Barataria Bay
Charlotte Harbor	Terrebonne/Timbalier Bays
Caloosahatchee River	Vermilion/Atchafalaya Bays
Tampa Bay	Mermentau River
Suwannee River	Calcasieu Lake
Apalachee Bay	Sabine Lake
Apalachicola Bay	Galveston Bay
St. Andrew Bay	Brazos River
Choctawhatchee Bay	Matagorda Bay
Pensacola Bay	San Antonio Bay
Perdido Bay	Aransas Bay
Mobile Bay	Corpus Christi Bay
Mississippi Sound	Upper Laguna Madre/Baffin Bay
Lake Potchartrain/Borgne	Lower Laguna Madre

Table 2. Gulf of Mexico managed species by fisheries management plan, and the representative species for which EFH products were developed.

FMP/Species	Representative species
Gulf of Mexico Reef Fish	
Queen snapper	
Mutton snapper	X
Schoolmaster	
Blackfin snapper	
Red snapper	X
Cubera snapper	
Gray snapper	X
Dog snapper	
Mahogany snapper	
Lane snapper	X
Silk snapper	
Yellowtail snapper	X
Wenchman	
Vermilion snapper	X
Rock hind	
Speckled hind	
Yellowedge grouper	
Red hind	
Jewfish	
Red grouper	X
Misty grouper	
Warsaw grouper	
Snowy grouper	
Nassau grouper	
Black grouper	X
Yellowmouth grouper	
Gag	X
Scamp	X
Yellowfin grouper	
Bank sea bass	
Rock sea bass	
Black sea bass	
Goldface tilefish	
Blackline tilefish	
Anchor tilefish	
Blueline tilefish	
Tilefish	X
Greater amberjack	X
Lesser amberjack	X
Almaco jack	
Banded rudderfish	
White grunt	
Gray triggerfish	X

FMP/Species	Representative species
Coastal Migratory Pelagics	
King mackerel	X
Spanish mackerel	X
Cero	
Cobia	X
Little tunny	X
Dolphin	X
Bluefish	
Gulf of Mexico Shrimp	
Brown shrimp	X
Pink shrimp	X
Rock shrimp	
Royal red shrimp	
Seabob	
White shrimp	X
Gulf of Mexico Red Drum	
Red drum	X
Gulf/South Atlantic Spiny Lobster	
Spiny lobster	X
Slipper lobster	
Gulf of Mexico Stone Crab	
Stone crab (Menippe mercenaria)	X
M. adina	
M. adina X M. mercenaria	
Gulf of Mexico Corals	
Corals	X

Table 3. Estuarine and offshore occurrence and information sources for representative EFH species.

	Occurrence [1]		Information sources [2]			
FMP/Species	Estuarine	Offshore	ELMR	Data Atlas	Darnell Atlases	NOS/NMFS Data Review
Gulf of Mexico Reef Fish						
Mutton snapper	X	X		X		X
Red snapper		X		X		
Gray snapper	X	X	X	X		
Lane snapper	X	X		X		X
Yellowtail snapper	X	X		X		X
Vermilion snapper		X		X		
Red grouper		X		X		
Black grouper		X		X		
Gag	X	X				X
Scamp		X				X
Tilefish		X		X		
Greater amberjack		X		X		
Lesser amberjack		X				X
Gray triggerfish		X			X	
Coastal Migratory Pelagics						
King mackerel		X		X		
Spanish mackerel	X	X	X	X	X	
Cobia		X		X		
Little tunny		X		X		
Dolphin		X		X		
Gulf of Mexico Shrimp						
Brown shrimp	X	X	X	X		
Pink shrimp	X	X	X	X		
White shrimp	X	X	X	X		
Gulf of Mexico Red Drum						
Red drum	X	X	X	X		
Gulf/South Atlantic Spiny Lobster						
Spiny lobster	X	X	X	X		
Gulf of Mexico Stone Crab						
Stone crab (Menippe mercenaria)	X	X	X	X		
Gulf of Mexico Corals						
Corals		X		X		

[1]Occurrence is defined as significant use of estuarine or offshore habitat, and does not include incidental or rare occurrences.

[2]Information sources are coded as follows.

ELMR = Estuarine Living Marine Resources Vol. I (Nelson *et al.* 1992) and Vol. II (Pattillo *et al.* 1997) for the Gulf of Mexico.

Data Atlas = Gulf of Mexico Coastal and Ocean Zones Strategic Assessment: Data Atlas (Strategic Assessment Branch 1985).

Darnell Atlases = Northwestern and Eastern Gulf Shelf Bio-Atlases (Darnell *et al.* 1983; Darnell and Kleypas 1987)

NOS/NMFS Data Review = Review of available information by NOS and NMFS scientists for developing observed/not observed data.

STATUS

Listed below are the EFH items from the Work Plan* (NOS/BCB and NMFS/Galveston 1997). *The status of the initial products delivered to the Council is described for each item.

For practical reasons, especially cost of reproduction, the maps provided to the Council are printed in black and white, with the mapped information coded by gray scales. The original maps were developed in color, and many of the maps covering large regions were originally printed at a larger size. Examples are available at the BCB's Gulf of Mexico EFH web site.

1. Needs Assessment. Meetings and telephone calls were conducted to identify the types of EFH products to be developed for the Gulf of Mexico, and to determine how NOS could support their development.
COMPLETED October 1997

2 Work Plan. A detailed description of products and services, estimated costs, and schedule was developed (NOS/BCB and NMFS/Galveston 1997).
COMPLETED October 1997

3. Digital Spatial Framework. This item is the Gulf of Mexico portion of the nation-wide Digital Spatial Framework. It contains watersheds, river reaches, estuarine and coastal embayment boundaries, estuarine isohalines, and offshore boundaries. It has been used to map species and habitats. Map scales are 1:250K and 1:24 K for regional and individual estuary maps, respectively. BCB can be contacted for the FTP sites to obtain the digital geographic coverages.
COMPLETED March 1998

4. Additional Data Compilation. Many major fishery-independent data sets for the Gulf of Mexico were obtained and processed into a usable form by BCB, including SEAMAP, state trawl surveys, and GUS trawl surveys. Data from the State of Florida have been obtained, but not completely compiled.
COMPLETED January 1998 (except Florida)

5. ELMR Species/Estuary Tables. **Updated** ELMR species/estuary tables were provided in a digital format suitable for developing tables and maps. ELMR species/estuary tables from Nelson *et al.* (1992) were updated to contain data for relative abundance (highly abundant, abundant, common, rare, not found, and no data) in each estuary, by five life stages (adult, spawning, egg, larva, and juvenile), and month for five seasonal salinity zones (0-0.5, 0.5-5, 5-15, 15-25, and >25 ppt) for the existing ELMR species. Eight existing ELMR species are also representative species for Gulf of Mexico EFH work (Table 3). For larvae, spawning, and eggs of

these eight species, the existing ELMR information, which is based on three annual salinity zones, was revised (using literature) to the five seasonal salinity-zone format.

A formal update process was instigated for adults and juveniles of the eight representative ELMR species. In Alabama, Mississippi, and Louisiana, the adult/juvenile updates were conducted by compiling state resource survey data sets; analyzing the compiled data to determine relative abundance scales and relative abundances by estuary, salinity zone, and month; estimating relative abundances where adequate data were not available; and conducting peer review in each state.

Time constraints precluded completing the formal updating process for adults and juveniles in Texas and Florida. For Texas, the process has been completed up to the peer review step. Thus, the adult and juvenile information currently in the species/estuary tables should be considered draft. The Texas updates will be completed by spring, and final information will be provided at that time. The information currently provided for Florida is also considered draft. A preliminary update of adults and juveniles in Florida estuaries was developed by converting the existing three annual salinity-zone ELMR information to the five seasonal salinity zone format. The scientific literature was used for developing this conversion. Updated five-zone ELMR information for adults and juveniles will be available for Florida by summer, when state reviews will be conducted in support of MMS's G-WIS project.
COMPLETED March 1998 (draft for Texas and Florida)

6. Non-ELMR Species/Estuary Tables (Observed/Not Observed). ELMR-like species/estuary tables were developed for representative estuarine species that are not covered in the existing ELMR database. This was required for four species: mutton snapper, lane snapper, yellowtail snapper, and gag (Table 3). However, due to time and resource constraints, the data content for the non-ELMR species consist only of observed or not observed for the adult, juvenile, and spawning life stages. The same estuaries, salinity zones, and months that were used for the updated ELMR species/estuary tables of Item 5 above were used for the non-ELMR species. The information was developed from literature (Hoese and Moore 1977; Johnson 1978) and through consultations with recognized experts from Texas A&M University (J. McEachran, R. McKee).
COMPLETED March 1998

7. Selected Estuarine Species Maps. Arc/Info digital and hardcopy maps were to be developed by estuary for two key estuarine species, red drum and brown shrimp. Because providing these products would have resulted in an impractically large number of maps for inclusion in the fisheries management plan amendments, this

task was dropped at the request of the Council and NMFS. However, these maps will be made available for all ELMR species in the future.
DROPPED January 1998

8. Digitized Atlas Maps for Offshore Species. Arc/Info covers were developed by digitizing existing atlas maps. Twenty-two species (Table 3) were mapped using NOS's *Gulf of Mexico Data Atlas* (Strategic Assessment Branch 1985). One species, gray triggerfish, is not mapped in the NOS Atlas, and was digitized from MMS's eastern and northwestern Gulf of Mexico atlases (Darnell and Kleypas 1987; Darnell *et al*. 1983).
COMPLETED March 1998

9. Non-Atlas Offshore Species Maps (Observed / Not observed). Observed/Not observed maps of offshore distribution were developed for representative species not covered in the NOS *Gulf of Mexico Data Atlas* (Strategic Assessment Branch 1985) or the MMS eastern (Darnell and Kleypas 1987) and northwestern (Darnell *et al.* 1983) Gulf of Mexico atlases. This was completed for three species: gag, scamp, and lesser amberjack (Table 3). The information was developed from literature (Hoese and Moore 1977; Johnson 1978) and through consultations with recognized experts from Texas A&M University (J. McEachran, R. McKee).
COMPLETED March 1998

10. Estuary / Embayment Habitat Maps. Maps of estuarine habitat (salinity and wetlands) were provided. Salinity maps were developed for each estuary, consisting of five depth-averaged salinity zones (0-0.5, 0.5-5, 5-15, 15-25, and >25 ppt) for four salinity (hydrographic) seasons (low, increasing, high, and decreasing) (Orlando et al. 1993). These were developed by updating the Orlando et al. (1993) database using state hydrographic data sets and contouring the data. The "salinity seasons" vary by estuary across the Gulf of Mexico. For example, the low salinity season in Aransas Bay, Texas occurs in January-March, while in Sabine Lake, Texas, the low salinity season occurs in March-May.

BCB provided the report *NOAA's National Coastal Wetlands Inventory* (Field *et al.* 1991) to characterize the distribution of Gulf of Mexico wetlands. This report contains acreage estimates for ten wetland types by county and watershed, along with maps of county and watershed boundaries.
COMPLETED March 1998

11. Offshore Habitat Maps. Elevated features and artificial reefs were mapped in the offshore area. Elevated features consisted of coral reefs and elevated topography (not bathymetry). These were mapped using the NOS *Gulf of Mexico Data Atlas* (Strategic Assessment Branch 1985). Artificial reefs were mapped using draft Gulf-wide data set compiled by the Gulf States Marine Fishery Commission (provided by

R. Lukens). This data set was edited to eliminate anomalous and duplicate data, and was checked against an independent data set for Florida (Pybas 1997).
COMPLETED March 1998

12. Regional Estuarine Salinity and Relative Abundance Maps. A mapping approach was developed to portray salinity and species relative abundances in estuaries grouped into three regions (Texas, Louisiana/Mississippi/Alabama, and Florida). Digital and hardcopy maps were developed at 1:24 K resolution by calendar season (Summer: June-August; Fall: September-November; Winter: December-February; Spring: March-May).

The regional portrayals of salinity are organized by the above calendar seasons for all Gulf of Mexico estuaries. This enables a user to look at a consistent seasonal time period across multiple estuaries to compare and contrast salinity habitat and the associated species distributions and relative abundances. The salinity patterns mapped for the calendar seasons were the dominant salinity season occurring during each calendar season. For example, if an estuary had high salinity during all the fall months, the high-salinity-season map was used for the fall map. However, if more than one salinity season occurred during a calendar season, the salinity season that occurred during two of the three months was mapped. For example, if the high-salinity season in an estuary occurred during September and October, and the decreasing-salinity season occurred during November, the regional fall-calendar map would contain the high-salinity-season contours for that estuary.

The juvenile life stage is shown on the regional species maps, since it is the dominant stage in Gulf of Mexico estuaries (Nelson *et al.* 1992). These maps were developed for all 12 representative species that occur in estuaries (Table 3). The regional species maps show the highest seasonal relative abundance estimate in each calendar-season salinity zone for each estuary. The relative abundance values are plotted in the calendar-season salinity contours described above.
COMPLETED March 1998

13. Life History Tables and Text. BCB provided digital text summaries and life history table data to the Council from the ELMR report: ELMR *Gulf of Mexico Vol. II* (Pattillo *et al.* 1997). The council used this and other information to develop the EFH life history tables.
COMPLETED November 1997

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REFERENCES

Darnell, R.M., R.E. Defenbaugh, and D. Moore. 1983. Northwestern gulf shelf bio-atlas. A study of the distribution of demersal fishes and penaeid shrimp of soft bottoms of the continental shelf from the Rio Grande to the Mississippi River delta. Open File Report 82-04. Metairie, LA: Minerals Management Service, Gulf of Mexico OCS Regional Office. 438 pp.

Darnell, R.M. and J.A. Kleypas. 1987. Eastern gulf shelf bio-atlas. A study of the distribution of demersal fishes and penaeid shrimp of soft bottoms of the continental shelf from the Mississippi River delta to the Florida Keys. OCS Study, MMS 86-0041. New Orleans, LA: Minerals Management Service, Gulf of Mexico OCS Region. 548 pp.

Field, D.W., A.J. Reyer, P.V. Genovese, and B.D. Shearer. 1991. Coastal wetlands of the United States: An accounting of a valuable national resource. Rockville, MD: National Oceanic and Atmospheric Administration, Strategic Assessment Branch. 59 pp.

Hoese, H.D. and R.H. Moore. 1977. Fishes of the Gulf of Mexico. College Station, TX: Texas A&M Universaity Press. 327 pp.

Johnson, G.D. 1978. Development of fishes of the Mid-Atlantic Bight: An atlas of egg, larval, and juvenile stages, Vol. IV, Carangidae through Ephippidae. Washington, DC: U.S. Fish and Wildlife Service. Biological Report FWS/OBS-78/12. 314 pp.

National Marine Fisheries Service. 1998. Technical guidance to NMFS for implementing the Essential Fish Habitat requirements for the Magnuson-Stevens Act. (Draft Report, January 8, 1998). Silver Spring, MD: National Marine Fisheries Service, Office of Habitat Conservation. 120 pp.

Nelson, D.M. (editor), M.E. Monaco, C.D. Williams, T.E. Czapla, M.E. Pattillo, L. Coston-Clements, L.R. Settle, and E.A. Irlandi. 1992. Distribution and abundance of fishes and invertebrates in Gulf of Mexico estuaries, Volume I: data summaries. ELMR Rep. No. 10. Rockville, MD: National Oceanic and Atmospheric Administration, Strategic Environmental Assessments Division. 273 pp.

NOS/BCB and NMFS/Galveston. 1997. Work Plan: Products and services for the identification of essential fish habitat in the Gulf of Mexico. Silver Spring, MD: National Oceanic and Atmospheric Administration, Strategic Environmental Assessments Division. 14 pp.

Orlando, S.P. Jr., L.P. Rozas, G.H. Ward, and C.J. Klein. 1993. Salinity characteristics of Gulf of Mexico estuaries. Silver Spring, MD: National Oceanic and Atmospheric Administration, Strategic Environmental Assessments Division. 209 pp.

Pattillo, M.E., T.E. Czapla, D.M. Nelson, and M.E. Monaco. 1997. Distribution and abundance of fishes and invertebrates in Gulf of Mexico estuaries, Volume II: Species life history summaries. Silver Spring, MD: National Oceanic and Atmospheric Administration, Strategic Environmental Assessments Division. 377 pp.

Pybas, D.W. 1997. Atlas of artificial reefs in Florida - fifth edition. Gainesville, FL: Florida Sea Grant College Program. 52 pp.

Strategic Assessment Branch. 1985. Gulf of Mexico coastal and ocean zones strategic assessment: Data atlas. Rockville, MD: National Oceanic and Atmospheric Administration, Strategic Assessment Branch. 161 pp.

Strategic Environmental Assessments Division. 1993. NOAA's Coastal Assessment Framework. Silver Spring, MD: National Oceanic and Atmospheric Administration, Strategic Environmental Assessments Division. 15 pp.

Strategic Environmental Assessments Division. 1997. Prospectus: February 1997. Gulf Wide Information System: ORCA component. Silver Spring, MD: National Oceanic and Atmospheric Administration, Strategic Environmental Assessments Division. 29 pp.